

A stylized globe with a thick black spiral path winding across it. The globe is rendered in shades of blue, green, and yellow. The spiral path starts from the top left and curves around the globe, ending at the bottom right.

National Institute of Environmental Health Sciences | **Superfund Basic Research Program**

A LEGACY IN MULTIDISCIPLINARY RESEARCH

Charting a Course for Advancing Basic Research to Practice

Executive Summary

Report of the 2003 External Advisory Group

September 2003

Executive Summary

The National Institute of Environmental Health Sciences' (NIEHS) Superfund Basic Research Program (SBRP) was created under the 1986 Superfund Amendments and Reauthorization Act (SARA) to establish a university-based research program to help address the wide array of scientific uncertainties facing the Environmental Protection Agency's (EPA) Superfund program. Until 2001, when Congress chose to provide Program funds directly to the NIEHS, the SBRP received its funds as pass through dollars from the EPA. This change in funding strategy expands the research opportunities for the Program as it strives to address its mandates and allows for the use of additional funding mechanisms as well as changes to the grant award cycle.

The SBRP is preparing to release annual Requests for Applications (RFAs), beginning in Fall 2003. As the Program plans for the future, NIEHS considered an external review of the SBRP essential. In February of 2003, the NIEHS established an ad hoc External Advisory Group (EAG) as a working group of the National Advisory Environmental Health Sciences Council. The EAG, which consisted of sixteen individuals representing academia, industry, and federal and state agencies, served to identify the strengths and areas of productivity of the Program and assess the efforts undertaken to communicate the science emanating from the Program. In addition, the group provided insights on potential future directions for the Program. The EAG did not evaluate specific SBRP programs or individual projects within the programs, this having been conducted via competitive application and independent peer review processes.

Research and Programmatic Issues

The EAG review of the current status of the Program focused on the scope of the science funded, internal and external communication efforts, and programmatic management. The EAG believes that the SBRP is an active, vibrant, and significant program, citing the overall historical quality and relevance of SBRP-funded research and results. The EAG determined that SBRP-funded research remains highly relevant to the EPA Superfund goals, noting that the SBRP has been successful at enhancing investigations and remediation work at many hazardous waste sites across the country.

Research: The SBRP is the only NIEHS or NIH program to fund both biomedical and nonbiomedical research within the structure of a multi-project grant. The SBRP strives to assemble researchers from diverse disciplines to focus on a unifying theme. This cross-cutting focus and multidisciplinary nature enable the SBRP to address the range of environmental problems that exist at hazardous waste sites. The resultant synergy between biomedical and nonbiomedical projects research projects is crucial to the development of holistic evaluations of hazardous waste sites.

The SBRP has always emphasized the importance of a firm public health foundation and is well positioned to meet the challenge of translating research findings into public health practice. The multidisciplinary structure of the Program places it in a strong position to address complex public health issues that cannot be adequately resolved through the contributions of a single scientific discipline. The programmatic goal that basic research should lead to application is an important feature of the SBRP and supporting an effective integrated research approach maximizes the likelihood of achieving this goal.

The EAG recommended that the SBRP continue the integrated science approach in its funded research programs while working to develop additional mechanisms to identify and address unmet needs and emerging issues.

Communication: Without question, technology transfer, in the broadest sense, is the SBRP's *raison d'être*. Because of the ultimate goals of the SBRP — that is, enhancing decision making — the research results must be freely communicated at several levels, from the scientific community, to other agencies and to those affected. The Program views information and technology transfer activities to be a shared responsibility with efforts required by both the Program staff and the grantees. The grantees address this responsibility through technology and information transfer, community outreach, and training.

Clearly, technology and information transfer must be concerned with converting research results into practical applications. Grantees have selected several approaches to foster this exchange:

- SBRP grantees have an impressive record of peer-reviewed publications, with over 6,500 publications in the scientific literature. The existing SBRP web-accessible database containing all publications resulting from SBRP sponsorship is excellent. Suggested further refinements to the web search features will enhance the ability to access this rich data set.
- SBRP researchers communicate their findings at local, national and international scientific meetings, resulting in a successful transfer of science and technology both within and external to the scientific community. The EAG considered this activity to be laudable.
- A significant amount of SBRP-funded science has been converted to patents, suggesting current and future commercialization to field or other laboratory applications; however, the EAG recognized that it is difficult to assess other areas that have not progressed to the same extent.
- SBRP grantees have conducted research at more than 100 hazardous waste sites, which demonstrates the successful reduction of SBRP research to practice.
- In 2002, the Program established Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Initiatives designed to foster development of field applications of science and technology in the private sector. This mechanism appears to be a potentially valuable one to promote the movement of science into commercial or other field use.

The EAG recognized that Outreach has become a natural extension and an integral part of the Program; however, the EAG recommended that Outreach should be more effectively presented in future RFAs by more explicitly identifying overall outreach goals, priorities and audiences.

The concept of a multidisciplinary approach is also an integral aspect of SBRP-funded training and has a major impact on graduate and post-graduate students. The SBRP provides an environment that fosters the development of multi-faceted investigators within the interdisciplinary framework required to meet complex human and environmental health challenges. The EAG recommendations to enhance the SBRP's training efforts included increased involvement of students in Outreach activities and formal post-graduation tracking of students for documentation and evaluation purposes.

Management: There is a clear sense of commitment to the mission of the SBRP by the Program staff who actively work to promote the Program and continually seek ways to assist individual SBRP-funded programs in getting their message out. SBRP staff have reached out to EPA, the Agency for Toxic Substances and Disease Registry (ATSDR), and state agencies with the intent of promoting the use of the Program's research results and identifying potential future research needs. The EAG recommended that SBRP staff should continue to build upon their communication with EPA regions when SBRP-funded research involves investigations and applied technology at specific Superfund sites.

The SBRP staff have established several programmatic tools and information transfer mechanisms that serve as important common resources to the SBRP. These resources, which include the SBRP website, the monthly Research Briefs, web-based seminars, and support for scientific meetings and lectures, provide an important foundation for facilitating and tracking the efficacy of technology transfer within, across, and outside of institutional SBRP grantees. With respect to the existing resources, the EAG recommended 1) restructuring of the website to emphasize the overall science and technology output and value of the SBRP; 2) increasing the distribution of the Research Briefs to additional industry sectors; and 3) using the Research Briefs to illustrate science/technology transfers between investigators within, across, or external to their funded institution.

To ensure the growth and continued relevance of the SBRP, clearly defined program assessment plans such as metrics need to be incorporated into planning activities. The Program currently uses a variety of data to evaluate program successes; these include numbers of publications, patents, and students trained. The EAG recommended that additional qualitative metrics be incorporated to evaluate synergy, publication impact, graduate student success or career relevance, and success of technology transfer. The EAG noted that approaches to collecting and evaluating these, or other, measures are not yet developed.

Future Directions

Since its inception, the SBRP has been on the forefront of health and environmental research — the SBRP’s proactive, interdisciplinary approach is clearly exemplified by its early recognition of and involvement in research related to arsenic contamination, children’s environmental health, and the value of the use of wildlife as indicators of public health. The SBRP continues to look to the future and strives to maintain the cutting-edge nature of the Program. The EAG attempted to provide guidance in future directions for SBRP, placing particular emphasis on two aspects: utilization of existing and emerging cutting-edge science tools and approaches; and encouraging innovative, cross-cutting, systems-level interdisciplinary approaches. EAG discussion led to observations on particular research areas where members see the opportunity for innovative research that will be relevant to the SBRP mission. Many of these concepts build upon current Program elements and activities.

The EAG was encouraged to note that several current research projects utilize new tools and methods that are being developed through basic research in biomolecular sciences, especially those that relate to gene-environment relationships. To remain relevant and cutting-edge, the EAG recommended that the SBRP consider new research avenues, including:

- development and application of scientific approaches and methods that will advance the integration of human and ecological risk assessment;
- utilization of a dynamic systems-level approach to site characterization;
- development and application of methods to examine the theoretical and empirical connectivity between human health and ecological condition;
- design and implementation of studies to examine strategies for information transfer to communities and the resulting impacts on community attitudes and actions; and
- inclusion of researchers from a wider breadth of academic disciplines such as sociology, economics, ethnology, anthropology, psychology/behavioral medicine, and bioethics and philosophy to add additional insight to research design, interpretation, and communication.

In addition, the EAG recommended that the SBRP increase its emphasis on:

- development and application of advanced sensor systems to enhance site characterization;
- development and application of scientific approaches and methods that will advance the integration of biological systems and chemical-physical processes in mechanistic studies of environmental processes;
- development and application of new analysis and visualization methods to interpret environmental information;
- development and application of more vigorous mathematical methods to model environmental data;
- application of “omics” technologies to investigate the human and ecosystem health impacts of exposure-dose levels representative of real-world conditions at hazardous waste sites;
- development and application of increasingly sophisticated and innovative remediation approaches that rely on cooperative efforts of researchers from multiple disciplines;
- development and application of creative approaches to examine remediation and risk management such as those that involve theoretical approaches based on computational and statistically-based biological models;
- design and implementation of studies related to specific community groups who may be especially affected, such as the aged, children, and minorities or low-income populations; and
- development of interdisciplinary approaches to the study of Superfund events, sites, and chemicals to serve as a mechanism to further the synergistic goals of the SBRP.

To be positioned to most effectively address interdisciplinary research, the EAG felt that the SBRP should encourage the sharing of expertise among the SBRP community. Accordingly, mechanisms should be developed and applied that decrease impediments to inter-program collaboration. The goal would be to foster the sharing of resources, expertise, and to include increased scientific and logistical interchange amongst program directors. The working group also recommended the broadening of SBRP grant mechanisms beyond the “P” series to include a variety of types of “R” series grants to fulfill the Program mandates.

The EAG acknowledges several limitations to its evaluation and recommendations for future direction of the SBRP:

- The list of observations and opportunities for the future is by no means comprehensive nor can it be, given the pace of innovation in contemporary science;
- The EAG recognizes that the NIEHS does not direct the research envisioned and that the Program will consist of funded grant applications, approved on the basis of scientific quality; and
- While acknowledging resource restrictions faced by the Program, the EAG did not consider the resource issues generated by its observations and recommendations.

The EAG's view of the overall quality of SBRP-funded research and results is very favorable. The EAG believes that over the past 16 years the SBRP has established a remarkable record of research and outreach through its support of over 60 programs. The EAG found the Program to be strong, relevant, and well-focused to address its mandates. With respect to the future direction of the Program, the EAG believes that the SBRP has built a firm foundation to increase opportunities to merge cutting-edge technologies with hypothesis-driven research. The EAG supports the SBRP's aim to apply systems approaches using innovative technologies to address environmental health issues. The EAG regards the SBRP strategy of annual competition as a valuable opportunity for the Program to become increasingly responsive to emerging issues.

The EAG believes that this review of the SBRP accurately reflects its perceptions and study of the present status of the Program. Recommendations for future directions or improvement of the Program represent its best efforts, based on the information supplied and acquired. The EAG would like to acknowledge the assistance received during this process. The SBRP staff provided extensive background materials and was available to provide additional information as needed. Mr. Larry Reed, EPA, served as Executive Secretary, functioning as liaison between the EAG and SBRP staff. Mr. Reed provided invaluable support to Dr. Daniel Baden and the entire EAG. We are also appreciative of the editorial support provided by Ms. Kerry Murray and Ms. Maureen Avakian of MDB, Inc.